

SOUTHEAST COMMUNITY COLLEGE
ADVANCED TECHNOLOGIES & SKILLED TRADES DIVISION
Energy Generation Operations Technology Program
Revision Date: March 2026

I. CATALOG DESCRIPTION

Course Number: ENER2120
Course Title: Boilers and Steam Turbines
Prerequisite(s): ENER1115
Catalog Description: This is an introduction to the basic operation and maintenance of boilers and steam turbines. Practical system block diagrams are presented and explained for steam turbine systems as used in industrial processing plants such as biofuels and electricity-generating plants. System flow diagrams and block-level troubleshooting techniques are covered. Emphasis throughout is on the vital interrelationship of operation, maintenance, inspection, controls, and safety devices.
Credit Hours: 3
Class Hours: 45
Lab Hours: 0
Total Contact Hours: 45

II. COURSE OBJECTIVES: *Course will:*

- A. Introduce students to boiler theory and operations.
- B. Provide students with information about a variety of boiler types and uses.
- C. Introduce students to heat engines, prime movers and steam engines.
- D. Introduce students to steam and its particular attributes.
- E. Describe various types of steam turbines and their major components.
- F. Discuss the common auxiliary systems used to support steam turbines.
- G. Provide an overview of the major components of a typical high pressure steam generator.

III. STUDENT LEARNING OUTCOMES AND GENERAL EDUCATION LEARNING OUTCOMES:

- A. Student Learning Outcomes: *Student will be able to:*
 - 1. Describe the purpose, content and application of the boiler and pressure vessel codes and regulations.
 - 2. Describe the thermodynamics and properties of steam.
 - 3. Explain basic boiler terminology.
 - 4. Describe various types and functions of low-pressure boilers.
 - 5. Describe common concepts associated with heat engines, prime movers and steam engines.
 - 6. Demonstrate fundamental knowledge of steam as it applies to industrial steam turbines.
 - 7. Describe the principle of operation and major components of various types of steam turbines.
 - 8. Explain the various auxiliary systems used to support operation of steam turbines.
 - 9. Describe and explain the design, operations and applications of various types of condensers used with steam turbines.
 - 10. Describe the major systems of a typical high pressure steam generator as used in modern power plants.
- B. General Education Learning Outcomes (GELOs)

1. GELO #3: Critical Thinking & Problem Solving
Outcome 1: Collect, identify, interpret and analyze data.

IV. CONTENT/TOPICAL OUTLINE

- A. Boiler Operation Principles**
 1. Properties of Steam
 2. Thermodynamic properties
 3. Types of Boilers
 4. Feedwater Systems
 5. Fuel Systems
 6. Draft Systems
 7. Boiler Water Treatment
 8. Boiler Operation Procedures
 9. Hot Water Heating Systems
- B. Introduction to High Pressure Steam**
 1. Steam Description
 2. Principle Applications of HP Steam
 3. Flash Steam
 4. Steam Tables
 5. Wet Steam vs. Dry Steam
- C. High Pressure Boilers**
 1. Primary Systems in High Pressure Boilers
 - a. Feedwater Systems
 - b. Fuel Systems
 - c. Steam Systems
 - d. Air (draft) Systems
 2. Operator Responsibilities
 - a. Start-up Procedures
 - b. Shut-down Procedures
 3. Boiler Monitoring
- D. Heat Engines, Prime Movers and Simple Steam Engines**
 1. The Industrial Revolution
 2. Heat Engines and Prime Movers
 3. Steam Engines
- E. Steam Turbine Designs and Construction**
 1. Turbine Types and Applications
 2. Turbine Casings
 3. Turbine Rotors
 4. Shaft Seals
 5. Steam Turbine Bearings
 6. Turbine Thrust, expansion and anchoring systems
 7. Impulse Turbine Operating Principles
 8. Turbine Blade Velocity Diagrams
 9. Turbine Blade Characteristics
 10. Steam Nozzles
 11. Impulse and reaction Turbine Pressure-Velocity Profile
 12. Impulse Turbine Staging
 13. Sentinel Valves
 14. Disc and drum Rotors
 15. Blade Attachment and Sealing
 16. Speed Reduction Gear Sets

- F.** Steam Turbine Auxiliary Systems
 - 1. Turning Gears
 - 2. Thrust Adjusting Gear
 - 3. Critical Speed
 - 4. Lubricating and jacking Oil Systems
 - 5. Flexible Couplings
 - 6. Various types of steam valves
 - 7. Electronic and mechanical over speed Trip Systems
 - 8. Steam Turbine Supervisory Equipment
 - 9. Barring Gears
 - 10. Condensing Turbine Circuits
 - 11. Governor System details
 - 12. Isochronous Control
 - 13. Starting and stopping various types of turbines
- G.** Steam Condenser Systems
 - 1. Principles of Condenser Operations
 - 2. Condenser Designs
 - 3. Condenser Performance and calculations
 - 4. Troubleshooting Procedures
 - 5. Purpose and Principles of Air Ejectors
 - 6. Purpose and designs of Cooling Water Systems
 - 7. Condenser Exhaust Valves
 - 8. Condensate Pumps
 - 9. Simple Steam Plant
 - 10. Condenser Types and construction
 - 11. Air Leaks
 - 12. Condenser Safety Devices
 - 13. Detection of Cooling Water Leaks
 - 14. Repair of Cooling Water Leaks
 - 15. Extraction or Condensate Pumps
 - 16. Feedwater Heaters

V. INSTRUCTIONAL MATERIALS

- A.** Required Text(s):
 - 1. Walker, ATP, Daryl R., and Steingress, Frederick M., *Low Pressure Boilers*, 5th Edition
 - 2. Steingress, Frederick M., *Low Pressure Boilers Study Guide*, 4th Edition
 - 3. Howlett II, H.C., *The Industrial Operators Handbook*
 - 4. Thomas, Charles E., CENGAGE, *Process Technology Equipment and Systems*
 - 5. online materials
- B.** Outside Reading/Research required: Internet Research assignments and as assigned.
- C.** Supplies: As assigned.

VI. METHODS OF PRESENTATION/INSTRUCTION

- A.** Methods of presentation typically include a combination of the following:
 - 1. Hybrid class (online plus traditional classroom)

VII. METHODS OF EVALUATION

- A.** Methods of evaluation, although determined by the individual instructor, traditionally includes a combination of the following:

1. Class participation
2. Regular assignments
3. Written exams and/or quizzes
4. Performance and observational assessments

VIII. SPECIFIC COURSE REQUIREMENTS

- A.** A minimum grade of “C” or a minimum of 70% is required to receive credit for this course.
- B.** Cheating within the Manufacturing Division: Any violation of academic integrity on assignments, quizzes, or tests will result in a grade of 0 on that assignment, quiz, or test. A second violation in any course after the initial infraction will result in a grade of F for that course. Any additional violations while in the program will result in a suspension from the program. For additional information, refer to the Academic Integrity pamphlet available from Student Services.
- C.** Credit by Examination: Credit for the course CANNOT be earned through Credit by Examination.